INDOOR AIR QUALITY ASSESSMENT

Medford High School
489 Winthrop Street
Medford, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
September, 2001

Background/Introduction

At the request of a parent and Karen Rose, Director for the Medford Board of Health, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at Medford High School.

Visits were made to this school on May 8th and 11th, 2001 by Cory Holmes, Environmental Analyst of the Emergency Response/Indoor Air Quality (ER/IAQ) Program, and Suzan Donahue, ER/IAQ Research Analyst to conduct an indoor air quality assessment. Michael Feeney, Chief of ER/IAQ, also visited the school on May 11, 2001 to assess the vocational wing of the school. BEHA staff returned again on May 30, 2001 to observe conditions on the roof. Ms. Rose accompanied BEHA staff on all three days of the overall assessment.

The school is a three-story building constructed in 1970 and is made up of a number of wings housing grades 9-12. The school also contains an early childhood center for pre-school children. A-wing is two stories and contains music rooms, art rooms and the auditorium. Science and business classrooms, as well as administrative offices, are located in B-wing. The C-wing is made up of general classrooms and a cafeteria on each of the three floors. A vocational/technical center contains various shop areas and a sports facility in the rear of the building, which includes a pool area. Windows throughout the building are openable, however school staff reported that they are difficult to open in a number of areas (e.g. damaged equipment, missing cranks) (see Picture 1).

The Medford School Department (MSD) is currently examining a number of capital and repair projects that will improve overall conditions in the school, including extensive repair and maintenance on the school's heating, ventilation and air conditioning (HVAC) systems, window repairs and glass replacement, roof repairs, as well as interior renovations in a number of areas (MSD, 2001). A copy of the capital and repair project list was provided to BEHA staff and is included as Attachment I. In addition, the MSD has hired a professional HVAC engineering firm to conduct a comprehensive assessment of the school's HVAC components including, 1) listing of all HVAC equipment and area served; 2) inspection of all HVAC and plumbing units to identify deficiencies as well as provide budget replacement costs; 3) performing life cycle analysis for current equipment and providing replacement costs; 4) providing service technicians to inspect and record system data; and 5) preparing and presenting a written report outlining existing conditions, recommended repairs, life cycle projections and budget costs (Gallagher, Inc., 2001). A copy of the HVAC equipment survey proposal was provided to BEHA staff and is included as Attachment II.

Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, Pen PTH8708 Thermo-Hygrometer. Carbon dioxide, temperature and relative humidity as well as carbon monoxide, were also taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Screening for total volatile organic compounds (TVOCs) was conducted using a

Thermo Environmental Instruments Inc., Model 580 Series, Photo Ionization Detector (PID).

Results

This school has a student population of approximately 1,300 and a staff of approximately 175. Tests were taken during normal operations at the school and results appear in Tables 1-24.

Discussion

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million of air (ppm) in forty-eight out of sixty-six areas surveyed on May 8, and in thirty-three out of one hundred seven areas surveyed on May 11. It is important to note that thirty-seven of the areas on May 8 and seventeen of the areas on May 11 which had elevated carbon dioxide levels were located in the C-wing, indicating an overall ventilation problem in this section of the school. It is also important to note that a large number of classrooms had open windows during the assessment, which can greatly contribute to reduced carbon dioxide levels. As just mentioned, a particular area of note is the C-wing, in which most areas surveyed had carbon dioxide levels above 1000 ppm even without occupancy and/or open windows and doors.

The MDPH approach to resolving indoor air quality problems is primarily two-fold, 1) improving ventilation to dilute and remove environmental pollutants and 2) reduce or eliminate exposure opportunities from materials that may be adversely affecting indoor air quality.

Ventilation

Fresh air in classrooms is supplied by a unit ventilator (univent) system. Univents in exterior classrooms draw air from outdoors through a fresh air intake located on the exterior walls of the building (see Picture 2) and return air through an air intake located at the base of each unit (see Figure 1). Interior rooms contain ceiling-mounted univents that are ducted to fresh air intakes on the roof (see Pictures 3 & 4). Several of these were damaged; the air intake in Picture 4 was being supported by a bucket (see Picture 5). Fresh air and return air are mixed, filtered, heated and provided to classrooms through a fresh air diffuser located in the top of the unit. Obstructions to airflow, such as papers and books stored on univents and bookcases, carts and desks in front of univent returns were seen in a number of classrooms. In order for univents to provide fresh air as designed, intakes must remain free of obstructions. Importantly, these units must remain "on" and allowed to operate while these rooms are occupied.

Exhaust ventilation in classrooms with univents is provided by a mechanical system. The exhaust system in classrooms consist of either ducted, grated wall vents powered by rooftop motors (see Picture 6) or unit exhaust ventilators. As with the univents, a number of exhaust vents were obstructed, deactivated or in disrepair. In order for exhaust ventilation to function as designed, vents must be activated and remain free of obstructions. With the absence or minimization of mechanical exhaust ventilation, pollutants generated during building occupancy will tend to linger. As an example, the Occupational Therapy (OT) Department has a lingering rubber mat odor, most likely from lack of airflow.

Mechanical Ventilation in offices and common areas (auditorium, library, gymnasium/locker rooms, etc.) is provided by air handling units (AHUs) (see Picture 7). Air is distributed by ducted, ceiling vents located throughout the building. Several air diffusers were sealed with plastic sheeting and/or cardboard (see Pictures 8 & 9). Alterations of the system such as these can interfere with proper airflow and balancing, resulting in the creation of uneven heating/cooling conditions in other areas. Exhaust ventilation is provided by wall or ceiling-mounted grates that return air back to the AHUs via ductwork.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. According to school department officials, the date of the last balancing of these systems was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings were within a range of 72^{o} F to 80 ^{o} F on May 8 and a range of 72^{o} F to 90 ^{o} F on May 11. The BEHA recommends that indoor air temperatures be maintained in a range of 70 ^{o} F to 78 ^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Temperature control complaints were expressed to BEHA staff in a number of areas. It is difficult to control temperature and maintain comfort without the air handling equipment operating as designed (e.g., univents deactivated, non-operable exhaust motors). In many cases concerning indoor air quality, fluctuations of temperature in

occupied spaces are typically experienced, even in a building with an adequate fresh air supply. While temperature readings outside the recommended range are generally not a health concern, increased temperature can affect the relative humidity in a building.

All temperature measurements in the vocational wing and some areas of B-wing were above the BEHA comfort guidelines. B-wing contains a number of computer rooms. Computer equipment and printers can generate waste heat while they operate, which can build up over time in an area without adequate ventilation. Lack of ventilation can lead to poor air quality and comfort complaints.

The relative humidity in the building was below the BEHA recommended comfort range in most of the areas sampled during the visits. Relative humidity measurements ranged from twenty-three to forty-two percent on May 8 and from fourteen to forty percent on May 11. The BEHA recommends that indoor air relative humidity is comfortable in a range of forty to sixty percent. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

It is important to note however, that relative humidity measured indoors exceeded outdoor measurements (range +1-11 percent and 1-7 percent on May 8 and 11 respectively). This increase in relative humidity can indicate that the exhaust system alone is not operating sufficiently to remove normal indoor air pollutants (e.g., water vapor from respiration). Primarily, C-wing contained rooms with higher relative humidity ranges, further indicating a lack of adequate ventilation.

Moisture removal is important since the sensation of heat conditions increases as relative humidity increases. As indoor temperatures rise, the addition of more relative

humidity will make occupants feel hotter. If moisture is removed, the comfort of the individuals is increased. Removal of moisture from the air, however, can have some negative effects. Relative humidity levels would be expected to drop during the winter months. The sensation of dryness and irritation is common in a low relative humidity environment. Humidity is more difficult to control during the winter heating season. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

The building has had a history of water damage, most notably the art wing, library, the science wing and the AV workroom off the library. A number of classrooms and common areas throughout the building have water-damaged ceiling tiles and other building materials, which indicate leaks from either the roof or plumbing system (see Pictures 10-12). Possible mold growth was identified on a support beam near the ceiling in second floor art rooms (see Pictures 12 & 13).

The area with the most substantial water damage appeared to be in the science wing as a result of piping/valves of science classrooms. An active leak was observed in this area with buckets stationed beneath to collect water (see Picture 14 & 15). The leak was traced to a chemical bench in room B-314 from plumbing that had penetrated through a space in the floor around a drain, resulting in water damage to the ceiling system. Other areas had significant water damage. Room B III has substantial water damage to desk table tops. A mailbox is used to collect water from leaks to prevent further damage (see Picture 16). Increasing the difficulty of replacing ceiling tiles is the

suspended ceiling design. The system consists of a suspended ceiling of interlocking tiles, which requires the removal of a number of tiles (see Picture 17). This design renders replacement of water damaged tile difficult. Water-damaged ceiling tiles and other porous building materials can provide a source of microbial growth and should be replaced after a water leak is discovered. As an example, chronically moistened ceiling tiles in the print shop supply room have resulted in mold contamination (see Picture 18).

Pooling water was observed in a number of areas on the roof (see Pictures 19 & 20). The art rooms are located in a section of the building, which has a steep saw-tooth style roof (see Picture 21). The drainage system on roofs of this design are prone to blockage by debris (e.g., leaves, pine needles) or snow and/or ice dams during winter months, which cause water to accumulate in the trough sections of the roof. Also, roof drain strainers were either missing and/or clogged with debris (see Pictures 22 & 23). The freezing and thawing of water during winter months can lead to roof leaks and subsequent water penetration into the interior of the building. Pooling water can also become stagnant, which can lead to mold and bacterial growth that can be introduced into the building by rooftop fresh air intakes (see Picture 24). In addition, stagnant pools of water can serve as a breeding ground for mosquitoes.

Caulking around windows was crumbling/damaged throughout the building indicating that the water seal is no longer intact (see Picture 25). Water penetration through window frames can lead to mold growth under certain conditions. Replacement of caulking and repairs of window leaks are necessary to prevent water penetration.

Several classrooms contained a number of plants. Plant soil and drip pans can serve as a source of mold growth. Plants should also be located away from univents and

exhaust ventilation to prevent aerosolization of dirt, pollen or mold. The drafting room contained an aquarium. Aquariums should be cleaned regularly to prevent bacterial growth, mold growth and nuisance odors.

In some areas, spaces between the sink countertop and backsplash were noted. Repeated leakage or improper drainage/overflow can lead to water penetration of countertop wood, the cabinet interior and behind cabinets. Like other porous materials, if these materials become wet repeatedly it can provide a medium for mold growth.

Musty odors were detected in the office space in the library. The origin of the odors was traced to wet carpeting that had been damaged prior to the BEHA assessment. Water damaged carpeting was reported to have been removed, however remnants of carpeting were observed along the perimeter of the media office beneath furniture presumable too heavy to relocate in order to remove carpeting (see Picture 26). In addition, BEHA staff identified wet carpeting emitting musty odors in a closet across from the video room, in which carpet removal was overlooked (see Picture 27). The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that carpeting be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If carpets are not dried within this time frame, mold growth may occur. Water-damaged carpeting cannot be adequately cleaned to remove mold growth.

Water coolers were observed on carpeted areas in a few locations. To avoid water damage to carpeting and/or potential mold growth, a water-resistant material such as plastic or rubber matting should be installed beneath water coolers.

Other Concerns

A number of other conditions were noted during the assessment, which can affect indoor air quality. BEHA staff received several complaints concerning vehicle exhaust odors in A-wing. A school parking lot is located adjacent to this wing. Idling vehicles in the parking lot near the school can result in vehicle exhaust entrainment by the mechanical ventilation system and open windows under certain weather conditions; which may, in turn, provide opportunities for exposure to combustion products such as carbon monoxide. At the time of the assessment no vehicle exhaust odors or measurable levels of carbon monoxide were detected within the school. M.G.L. chapter 90 section 16A prohibits the unnecessary operation of the engine of a motor vehicle for a foreseeable time in excess of five minutes (MGL, 1996).

Several areas had missing/dislodged ceiling tiles. Missing ceiling tiles can provide an egress for dirt, dust and particulate matter into occupied areas. Also of note was the amount of materials stored in some areas. Items were seen piled on windowsills, tabletops, counters, bookcases and desks in classrooms throughout the school. The large amount of items stored allows for dusts and dirt to accumulate. These stored items, (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Dust can be irritating to the eyes, nose and respiratory tract.

Several classrooms contained dry erase boards and dry erase board markers. Accumulated chalk dust or dry erase board particles were noted in several classrooms (see Picture 28). These materials are fine particulate, which can be easily aerosolized and serve as eye and respiratory irritants. In addition, materials such as dry erase markers and

dry erase board cleaners may contain volatile organic compounds (VOCs), (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can also be irritating to the eyes, nose and throat.

The main office and teachers' lounges have photocopiers. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). School personnel should ensure that local exhaust ventilation is activated while equipment is in use to help reduce excess heat and odors in these areas.

Cigarette butts were observed and the odor of cigarette smoke was noted in several restrooms, the second floor A-wing storeroom and in the B-wing back stairwell (see Pictures 29 & 30). Environmental tobacco smoke can have a marked effect on indoor air quality. Environmental tobacco smoke is an indoor air pollutant, a respiratory irritant and can exacerbate the frequency and severity of symptoms in asthmatics. The most effective method of preventing exposure to environmental tobacco smoke is to have smoke free buildings. M.G.L. Chapter 270, Sec. 22 prohibits smoking in public buildings, except in an area which has been specifically designed as a smoking area (M.G.L., 1987).

Air fresheners were being used in several areas (see Tables). Air fresheners contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. In addition, air fresheners do not remove materials causing odors, but rather mask odors which may be present in the area.

A number of indoor air complaints were expressed in the gymnasium, locker rooms and health education wing, including poor ventilation, damaged insulation, steam

leaks, excessive heat and active roof leaks (see Tables). In the boy's locker room strong urine odors were noted. BEHA staff observed a clogged toilet filled with stagnant and discolored water. School staff reported that this toilet has not been operable for some time.

Science Wing Chemical Storage

In many instances, chemicals were found stored in classrooms. Of note were the conditions that indicate improper storage of chemicals that may pose fire and safety hazards. Of prime concern is the condition of the cabinet in the B-321 prep room (see Picture 31), which is used to store flammable substances (see Table 25). The cabinet contains a wooden box that is labeled "phosphorous pentachloride" and is encrusted with chemical crystals (see Picture 32). Phosphorous pentachloride is a highly reactive material that forms chlorides and chlorine gas when ignited (CAMEO, 1999). Phosphorous pentachloride should be stored separate from flammable substances (FSI, 1999). The condition of the wooden box indicates that the fastener may be corroded and contaminated with chemical crystallization. Next to the box is a metal container that is heavily corroded (see Picture 33). This corrosion can compromise the integrity of the container. Both of these containers should be removed by an experienced hazardous waste remediator to prevent accidental release of the contents.

The B-321 storage cabinet appears to be an older vintage, flameproof cabinet. Heavy rust on the passive vents of the cabinet door (see Picture 34), corroded metal of shelf supports and other metal surfaces were observed. This cabinet is not designed to meet the current standards for storing flammable materials set by the National Fire

Protection Association (NFPA, 1996). The design of the chemical cabinet provides minimal protection for stored materials in the case of a fire. In this configuration, vapors from stored chemicals can migrate into the chemical prep area through the door vents. Exposure to vapors of off-gassing chemicals can be irritating to the eyes, nose and respiratory system. Please note that the material that serves as the liner for the cabinet is also damaged. If this fireproofing material contains asbestos, damage by mechanical means of contact with corrosives can render asbestos friable. Friable asbestos can become airborne and poses a respiratory/pulmonary hazard. VOCs can react with metals, as demonstrated by the interior of the flameproof cabinet. Other conditions observed within this storage cabinet include:

- Storage of metal canisters that can degrade when exposed to organic solvents.
- Flasks containing chemicals that were sealed with glass stoppers held in place with string (see Picture 35) or rubber stoppers. Use of these stoppers can lead to the slow evaporation of materials.
- Bottles filled with chemicals labeled by chemical formula. It is good safety practice to label bottles with chemical name.
- Containers with degraded or missing labels (see Picture 36).
- Containers in cardboard boxes, that can absorb off-gassing chemicals.

Other problems in science classrooms, which are or can be a source of off-gassing chemicals; fire and/or a safety hazard, were also noted. In general, the following conditions were observed in classrooms and other areas throughout the science area:

- Chemicals were found with no labels or labeled in a manner difficult for an untrained person to read.
- Reuse of original bottles for storage of other chemicals.
- Open shelves did not have guards at edge to prevent container breakage.

The following problems were denoted in individual science classrooms.

B-323-former dark room

- Three bottles of an unidentified material were stored in a cabinet beneath a sink (see Picture 37). Crystallized materials were noted in these containers.

B-316

- A bottle of nitric acid had crystallized product around its cap, indicating release of the acid from the bottle (see Picture 38).
- An organic solvent (dichloromethane), iodine, bromine water and an alkaline material (ammonium hydroxide) were stored in the same cabinet as strong acids (hydrochloric and nitric acids). These potentially reactive materials should be stored separately.
- Containers of crystallized sodium hydroxide were stored with acids (see Picture 39). These containers are "sealed" with beakers.
- Acids were stored in a cabinet with shelves with metal supports. Acids should be stored in an acid resistant cabinet.
- A cabinet contains spilled powdered residue of an unidentified substance, which would require identification and removal as a hazardous waste (see Picture 40).

B-314

- There are three chemical hoods that were individually labeled “concentrated hydrochloric acid”, “hexane”, and “ammonium hydroxide”. The “hexane” and “ammonium hydroxide” chemical hoods had stock bottles of each hazardous material stored inside the cabinet with the fan deactivated. The purpose of chemical hoods is to draw aerosolized chemical vapors and odors from the work area out of the building. Chemical hoods should not be used for storage of unattended materials because this equipment can be deactivated during off-hours (Rose, S. L., 1984). If the chemical hood is deactivated, off-gassing materials can penetrate into adjacent areas. Chemical hoods should be on at all times that chemicals are within the equipment. It is also good chemical hygiene practice to return stock bottles back to the storage cabinet after use.
- The ceiling above the “hexane” chemical hood is heavily water damaged (see Picture 41). It was not determined if this water damage has led to degradation of hood operation and/or has created breaches in the cabinet via corrosion.
- Acids were stored in a wooden cabinet (see Table 26) on wooden shelves with metal supports. The metal supports were heavily corroded.
- Flammable materials were stored in a wooden cabinet (see Table 27).
- Unlabelled bottles were stored in an alkaline storage cabinet.

B-310

- Cases for mercury-containing thermometers were identified. Mercury is a hazardous material that can be released if these thermometers are broken. The Agency for Toxic Substances and Disease Registry (ATSDR) and the US Environmental Protection Agency (EPA) recommend that elemental mercury be properly stored and cleaned up if spilled.

B312

- Glass of a cabinet was stained with an unidentified black material (see Picture 42). This material should be removed as a hazardous waste. Also noted were stored bottles of hydrochloric acid that have signs of crystallization on containers.

It is highly recommended that a thorough inventory of chemicals in the science department be done to assess chemical storage and disposal in an appropriate manner consistent with Massachusetts hazardous waste laws.

Vocational/Technical Wing

A number of areas throughout the building demonstrated conditions that can result in the aerosolization of irritating materials into the school environment. Since MHS contains numerous Vocational Education Programs (VEPs), this section of the report will be divided into sections either by the shop activity or by the noted issues. In addition to repairing the ventilation system, the identification, proper storage of, or elimination of irritating materials would serve to improve indoor air quality. One

observation that is ubiquitous to all shops was the absence of operating exhaust ventilation to remove pollutants generated by operation of each VEP program. Routine use of chemicals in VEPs requires the operation of both general and localized, specially designed exhaust ventilation to minimize student/occupant's exposure to volatile organic compounds. Air monitoring for total volatile organic compounds (TVOCs) was conducted in all VEP areas. VOCs are found in many industrial/vocational products. At low concentrations, VOCs do not pose a long term health risk, however they can irritate the eyes, nose, throat and respiratory system of exposed individuals. In order to determine whether sources of VOCs existed in VEPs, an outdoor air measurement of ambient TVOCs was taken as a comparison value. In most VEPs assessed, air concentrations of TVOCs in the center of VEP rooms were two to ten times greater than the outdoor TVOC concentration (0.6 ppm) (see Table 28). In some cases, obvious sources of evaporating VOCs were identified. These TVOC concentrations indicate that VOCs are not readily removed from the indoor environment by the ventilation system.

V-202 Print Shop

Odors of organic solvents were detected upon entering the print shop area. An exhaust hood exists in the corner of this area. All efforts to activate this vent were not fruitful. Inside the print shop are a number of printers that use VOC containing materials. No local dedicated exhaust ventilation exists for any of the printers. It appears that the room was designed to have the broken exhaust hood draw evaporating VOCs across the room. The concentrations of TVOCs measured ranged from 4 ppm to 301 ppm (see Table 28), dependent upon the material sampled. TVOCs are the sum concentration of

various evaporating VOCs. Inks, washes and hand cleaners containing VOCs are used in this classroom. As previously mentioned, VOCs can be irritating to the eyes, nose, throat and respiratory system. Products containing VOCs must be used with adequate exhaust ventilation to prevent exposure. A large canvas laundry hamper was being used to collect various print shop wastes (see Picture 43), which contain VOCs that were off gassing during the assessment. A large fan is installed over the exterior garage type door in this area. It appears that the purpose of the fan is to provide air circulation. The operation of the fan may increase the airborne concentrations of TVOCs from the point sources identified and serve to distribute them throughout the print shop area.

V-211 Carpentry

Odors of organic solvents were detected upon entering the carpentry shop area. During the assessment, students were applying wood stain in an area near the hallway door. The application of this material produced a TVOC level of 15 ppm around the general area of the students and 4.7 ppm in the center of the room (see Table 28). This application was done in an area with minimal exhaust ventilation. Local exhaust ventilation is necessary to draw evaporating VOCs from a room to minimize solvent exposure.

V215-Former Machine Shop

This room is used for multiple purposes by the Metal Fabrication/HVAC Engineering and the Carpentry Shops. The carpentry shop uses this room for storage of paints and stains. These materials frequently contain flammable constituents and should

be stored in a cabinet that meets the current standards for storing flammable materials set by the National Fire Protection Association (NFPA, 1996). This area had a TVOC concentration of 7.4 ppm, which can be attributed to the drying of recently spray-painted materials in the room. This room also contains equipment that provides air conditioning for room V-219. Compressors for the V-219 vent directly into this room resulting in indoor temperatures of 90^{o} F. No operating exhaust ventilation system was identified in this area to help remove waste heat. Increased heat can also create conditions that make VOC containing compounds more readily aerosolized.

V-118 Cosmetology

The practice of cosmetology frequently requires the use of materials that contain VOCs, such as hairspray, sterilizing products and nail preparation products. As an example, TVOC concentrations were measured at 5.2 ppm immediately after hairspray was applied by a student (see Table 28). No local dedicated exhaust ventilation exists in this area. The concentrations of TVOCs measured ranged from 0.4 ppm to 22 ppm within the cosmetology area (see Table 28), dependent upon the material sampled. (Please note that the highest readings were taken 2 inches over an open container of product). TVOCs are the sum concentration of various evaporating VOCs. Products containing VOCs must be used with adequate exhaust ventilation to prevent exposure. During the assessment both the supply and exhaust ventilation systems were deactivated and a strong odor of nail polish was noted. Without dilution and removal via the mechanical ventilation system, these materials can build up resulting in eye and respiratory irritation to sensitive individuals.

Conclusions/Recommendations

The conditions noted at the Medford High/Vocational School raise a number of indoor air quality issues. Significant areas of the building have water damage from roof and/or plumbing leaks. The combination of the design of the building, maintenance, work hygiene practices and the condition of stored materials in the building, present conditions that can adversely influence indoor air quality. For these reasons a two-phase approach is required, consisting of **(short-term)** measures to improve air quality and **long-term** measures that will require planning and resources to adequately address overall indoor air quality concerns. In addition, the implementation of projects on the capital and repair project list (see Attachment I) as well recommendations from the intensive HVAC survey (see Attachment II) should greatly improve building conditions. In view of the findings at the time of the visits, the following **short-term** recommendations are made:

1. Exhaust ventilation in the vocational education wing must operate continuously during school hours. Failure to do so will allow for VOCs from products to build up within this section of the school.
2. Consult a hazardous waste remediation company concerning conditions of spilled materials and removal of phosphorous pentachloride and rusted containers from the flammable storage cabinet in the chemical prep room. Have a chemical inventory done in all storage areas and classrooms. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous materials.

3. Clean roof drain catches of debris to enhance rainwater drainage. Replace all missing/damaged drain catches to prevent drain clogs. Examine each roof drain for clogs and remove where found. Consider instituting roof inspections on a regular basis to examine catch basins for blockage.
4. Examine each univent and AHU for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers school-wide.
5. Inspect rooftop exhaust motors and belts for proper function, repair and replace as necessary.
6. Remove all blockages from univents, air diffusers and exhaust vents to facilitate airflow.
7. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control.
8. Thermostat settings throughout the complex should be evaluated. Thermostats should be set at temperatures to maintain comfort for building occupants.
9. Once both the fresh air supply and exhaust ventilation are functioning, the systems should be balanced by a ventilation engineering firm.
10. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, implementation of scrupulous cleaning practices should be implemented. This will minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is

low. Use of vacuum cleaning equipment outfitted with a high efficiency particulate arrestance (HEPA) filter is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

11. Report any roof leaks or other signs of water penetration to building maintenance for prompt remediation.

12. Move plants away from univents in classrooms. Examine drip pans for mold growth and disinfect areas of water leaks with an appropriate antimicrobial where necessary.

13. Examine water-damaged carpeting for mold growth. Discard carpet if moldy. Ensure all carpet remnants and backing materials are removed. Disinfect areas beneath and around carpeting with an appropriate antimicrobial.

14. Seal areas around sinks to prevent water-damage to the interior of cabinets and adjacent wallboard. Disinfect areas of microbial growth with an appropriate antimicrobial as needed.

15. Replace the B321 cabinet with one that meets the standards set by the National Fire Protection Association (NFPA, 1996) for storage of flammable substances.

16. Obtain an acid resistant cabinet for storage of acids.

17. Operate chemical hood exhaust fans at all times that chemicals are present within the equipment. Do not use chemical hoods for storage of chemicals. Examine the integrity of chemical hood cabinets and ductwork that is water damaged.

18. Secure thermometers containing mercury. Consider discontinuing the use of such thermometers and disposing these materials in accordance with Massachusetts hazardous waste disposal laws.

19. Obtain Material Safety Data Sheets (MSDS) for chemicals from manufacturers or suppliers. Maintain these MSDS' and train individuals in the proper use, storage and protective measures for each material in a manner consistent with the Massachusetts Right-To-Know Law, M.G.L. c. 111F (MGL, 1983).

20. Clean detergent from floor of cosmetology room. Keep detergent container sealed.

21. Replace missing ceiling tiles and fill utility holes and wall cracks to prevent the egress of dirt, dust and particulate matter between rooms and floors.

22. Repair/unclog toilet in boy's locker room. If not feasible, seal permanently and disconnect water supply.

23. Consider placing a water impermeable barrier beneath water coolers and fountains to prevent moistening of carpets.

24. Prohibit smoking in the building in accordance with Massachusetts law (M.G.L. Chapter 270, Sec. 22).

25. Refrain from using strong scented materials in offices and restrooms.

26. Relocate or consider reducing the amount of materials stored in offices/classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.

27. Change filters for air-handling equipment as per the manufacturer's instructions or more frequently if needed. Vacuum interior of units prior to activation to

prevent the aerosolization of dirt, dust and particulates. Ensure filters fit flush in their racks with no spaces in between allowing bypass of unfiltered air into the unit. Obtain air filter brackets to prevent air-bypass if multiple filters are installed in one rack.

28. Clean chalkboards and chalk trays regularly to prevent the build-up of excessive chalk dust and dry erase marker particulate.

29. Repair damaged insulation in boy's locker room.

30. Relocate bus parking area or have busses shut off engines after five minutes as required by Massachusetts General Laws 90:16A.

31. Consider developing a written notification system for building occupants to report indoor air quality issues/problems. Have these concerns relayed to the maintenance department/ building management in a manner to allow for a timely remediation of the problem.

The following **long-term** measures should be considered. A ventilation engineer should be consulted to resolve air supply/exhaust ventilation problems/issues building-wide. With regard to **each industrial shop program**, it is highly recommended that a certified industrial hygienist be consulted to evaluate the industrial hygiene practices and procedures in all shop areas and appropriate ventilation practices for the science area chemical storage rooms. The following areas should be addressed:

1. Examine the feasibility of enhancing drainage from low-lying roofs to reduce water pooling. This may include redirecting the pitch of the roof towards drains or installation of new drains.

2. Once roof is repaired, replace any remaining water-stained ceiling tiles. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
3. Repair and/or replace thermostats and pneumatic controls as necessary to maintain control of thermal comfort. Consider contacting an HVAC engineer concerning the repair and calibration of thermostats and pneumatic controls school-wide.
4. Repair/replace loose/broken windowpanes and missing or damaged window caulking building-wide to prevent water penetration through window frames.
5. Repair/replace faulty plumbing and valves in science wing to prevent leakage and subsequent water damage.
6. Examine the feasibility of installing local exhaust ventilation for printers in the print shop.
7. Examine the feasibility of installing a spray booth/drying room for application of VOC-containing materials.
8. Examine the feasibility of improving exhaust ventilation for the cosmetology area.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

CAMEO. 1999. Chemical Emergency Preparedness and Prevention Office. CD-ROM prepared by US Environmental Protection Agency and National Oceanic and Atmospheric Administration.

FSI. 1999. Flinn Scientific & Biological Catalog Reference Manual 1999. Flinn Scientific Inc., Batavia, IL.

Gallagher, Inc. 2001. Medford High School HVAC Equipment Survey provided by Thomas G. Gallagher, Inc., Mechanical Contractors. Cambridge MA.

MGL. 1983. Hazardous Substances Disclosure by Employers. Massachusetts General Laws. M.G.L. c. 111F.

MGL 1987. Smoking in Public Place. Massachusetts General Laws. M.G.L. c. 270, sec. 22.

MGL. 1996. Stopped motor vehicles; Operation of Engine; Time Limit; Penalty. Massachusetts General Laws. M.G.L. c. 90:16A.

MSD. 2001. Medford School Department Capital and Repair Projects for Medford High School. May 7, 2001.

NFPA. 1996. Flammable and Combustible Liquids Code. 1996 ed. National Fire Protection Association, Quincy, MA. NFPA 30.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Rose, S. L. 1984. *Clinical Laboratory Safety*. Van Nostrand Reinhold, New York, NY.

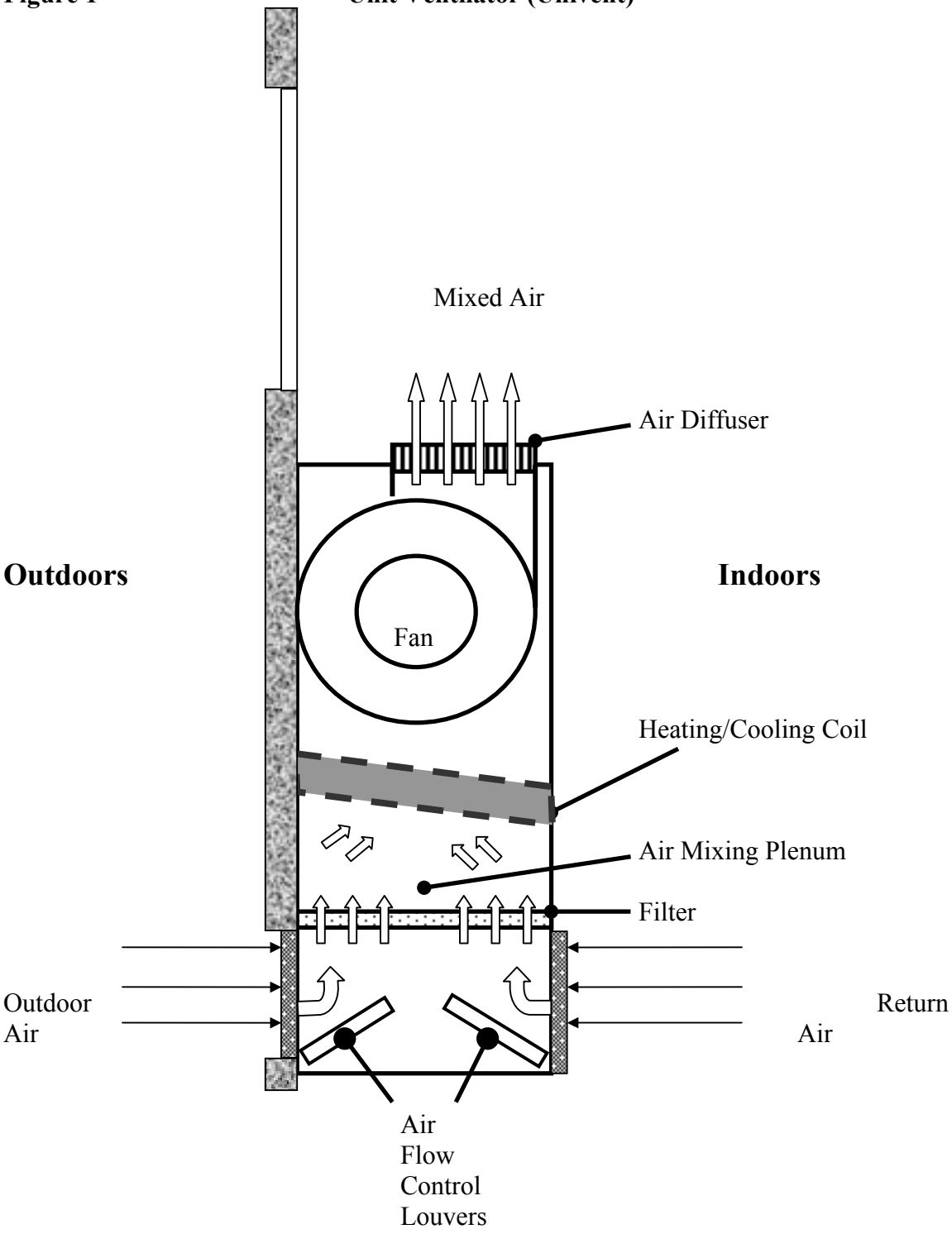
Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, WV.

Figure 1 **Unit Ventilator (Univent)**



Picture 1

Missing Crank on Classroom Window

Picture 2

Univent Fresh Air Intake (Right) Unit Exhaust Vent (Left)

Picture 3

Ceiling Mounted Univent in Interior Classroom

Picture 4

Air Intakes for Univents in Interior Classrooms
Note Bucket Stationed beneath Broken Intake Vent to Allow Airflow

Picture 5

Close Up Of Bucket Filled with Rust Chips in Picture 4

Picture 6

Wall Mounted Exhaust Vent Obstructed by Filing Cabinet

Picture 7

Ceiling Mounted AHU in Locker Room, Note Panel for Filter Bank Not Secured

Picture 8

Air Diffuser Blocked by Sheet Metal

Picture 9

Air Diffuser Blocked with Cardboard

Picture 10

Water Damaged/Missing Ceiling Tiles

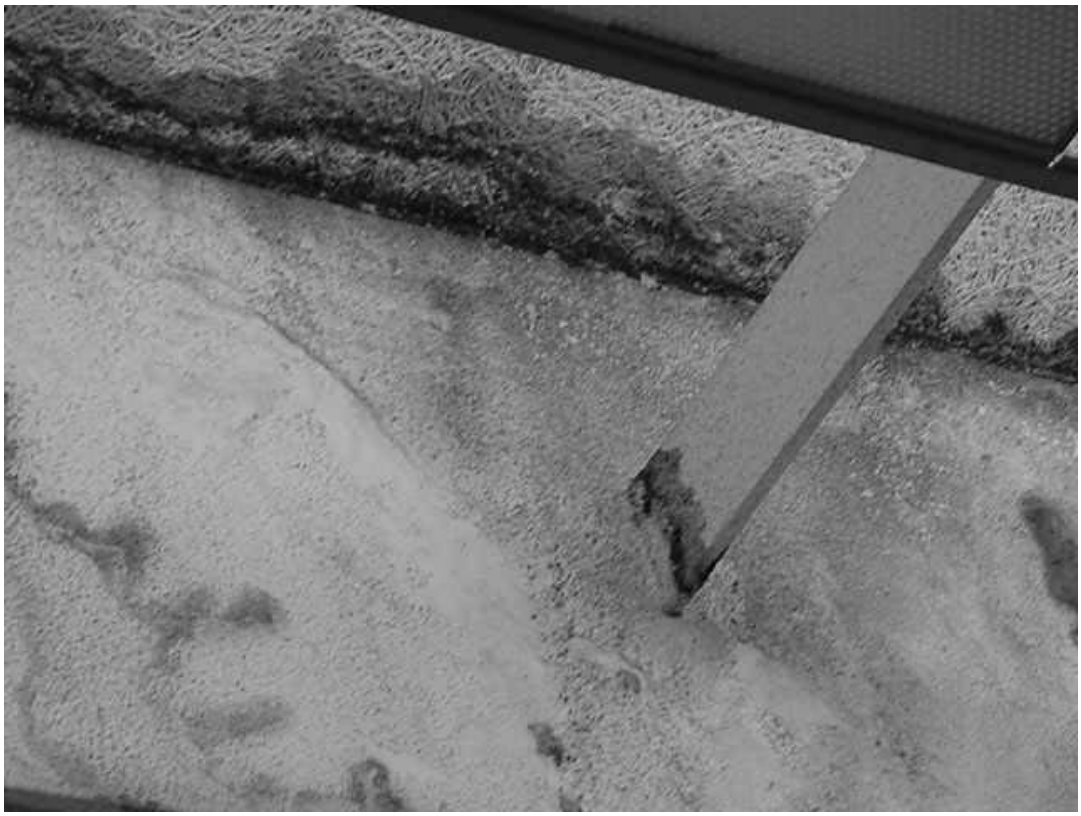
Picture 11

Water Damaged Ceiling Tiles with Possible Mold Growth (Sealed with Plastic)

Picture 12

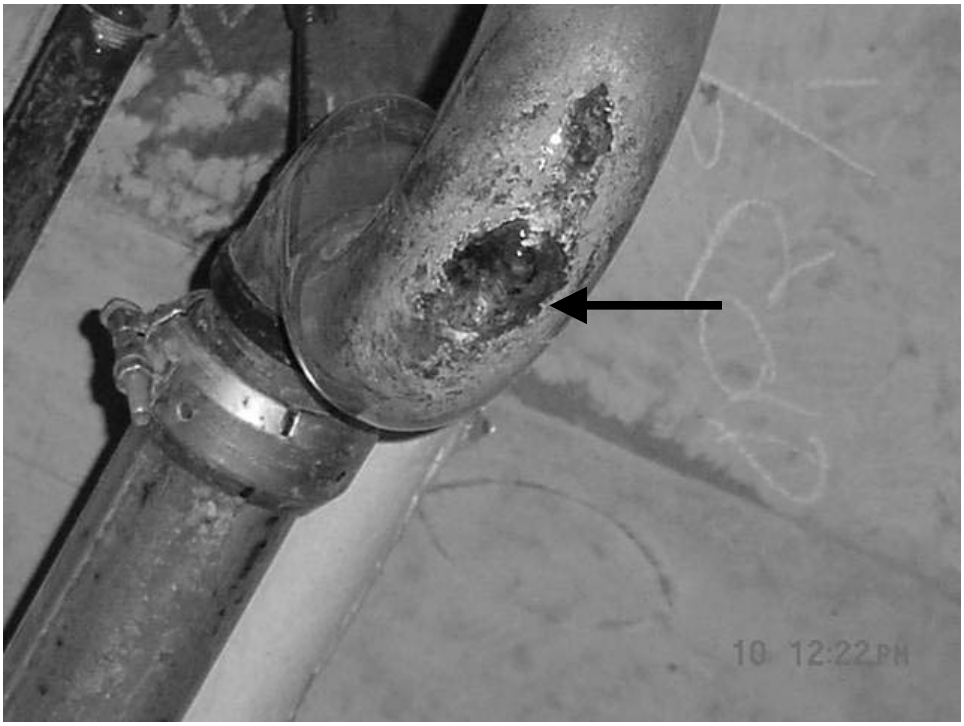
Water Damaged Support Beam and Ceiling Tiles in Art Room (Possible Mold Growth)

Picture 13



Close-Up of Water Damaged Area in Previous Picture

Picture 14



Leaking Plumbing Valve in Science Wing
Note Water Droplets

Picture 15

Bucket With Standing Water Stationed below Leak in Previous Picture

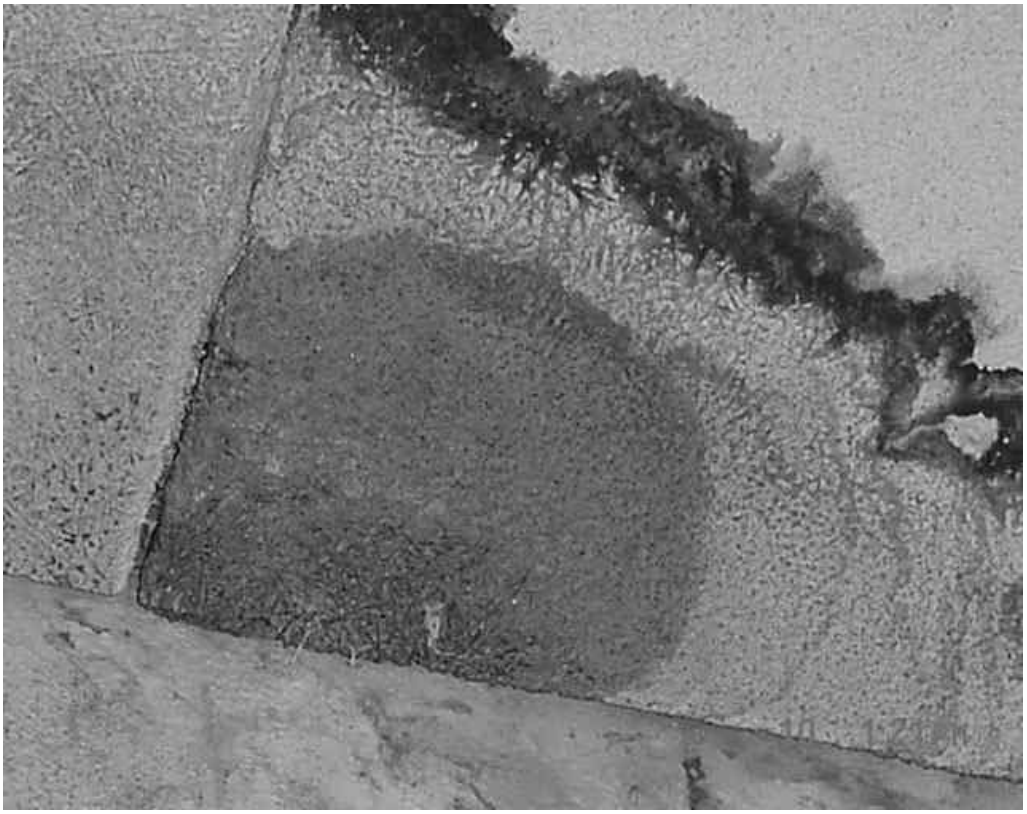
Picture 16

A Mail Box Is Used To Collect Water From Leaks To Prevent Further Damage To Desks In BIII

Picture 17

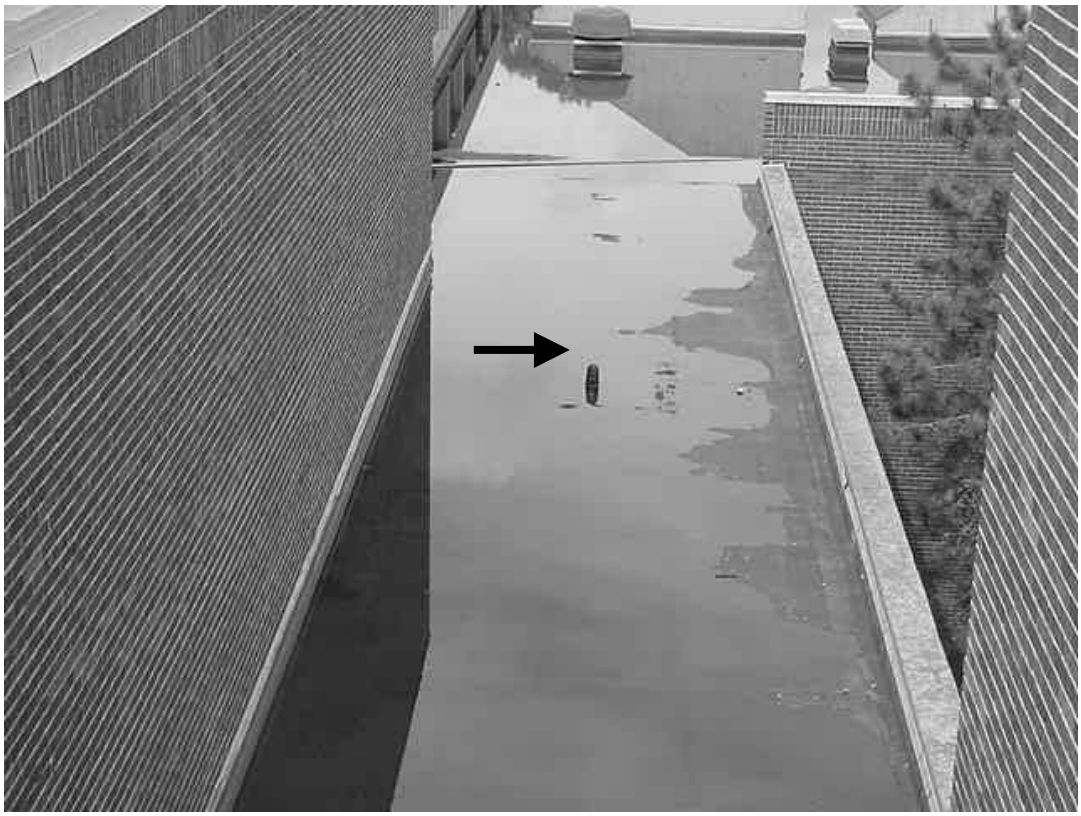
The Ceiling System Consists Of Interlocking Tiles

Picture 18



Mold Contamination of Ceiling Tiles in Print Shop Storeroom

Picture 19



Pooling Water on Roof Note Drain Indicated by Arrow

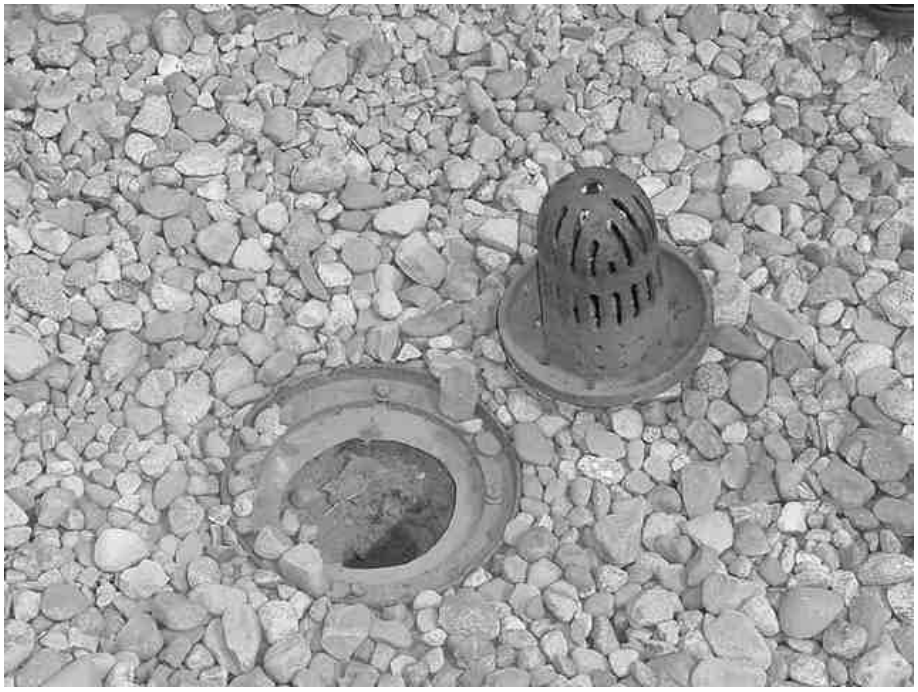
Picture 20

Pooling Water on Roof Note Plant Growth and Debris

Picture 21

Saw-Toothed Roof over Art Wing

Picture 22



Roof Drain, Note Strainer Not Secured

Picture 23

Close-Up Of Drain in Previous Picture, Note Drain Clogged With Stones

Picture 24

Pooling Water on Roof, Note Fresh Air Intake near Saw-Toothed Roof (Art Wing) In Background

Picture 25

Failing Caulking around Windows (Top)

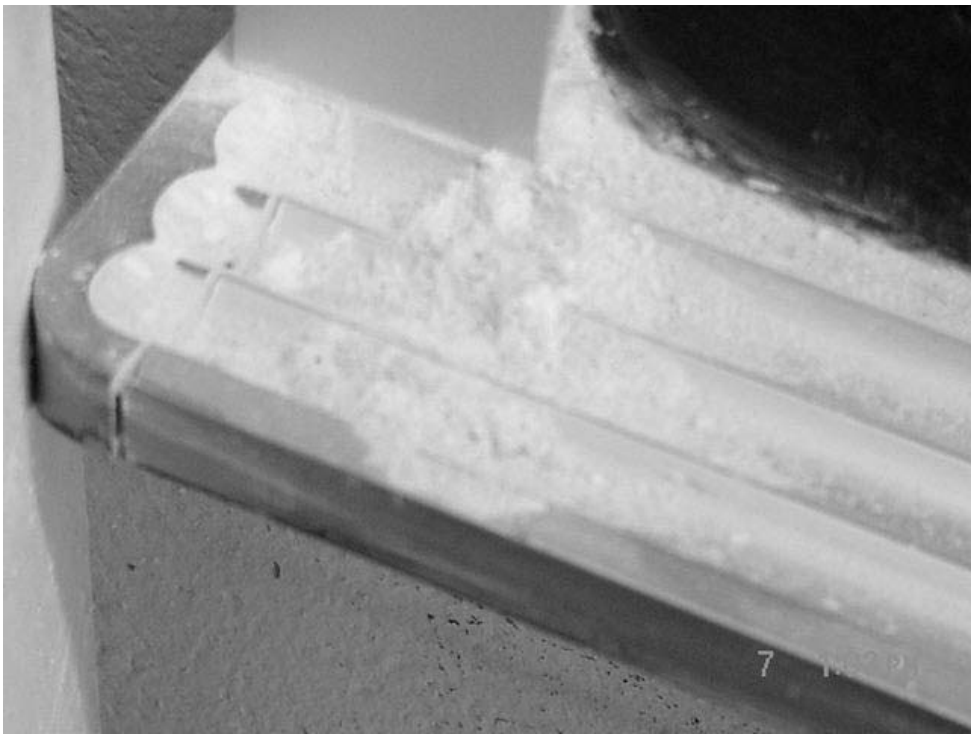
Picture 26

Remnants of Wet Water Damaged Carpeting beneath Furniture in Media Office

Picture 27

Water Damaged Carpeting in Closet Across From Video Room

Picture 28



Accumulated Chalk Dust in Classroom

Picture 29

Stairwell Support (Cap Removed) Used as Ashtray in B-Wing Rear Stairwell

Picture 30

Cigarette Butts in Toilet/Bathroom

Picture 31

Flammables Storage Cabinet In B-321 Prep Room

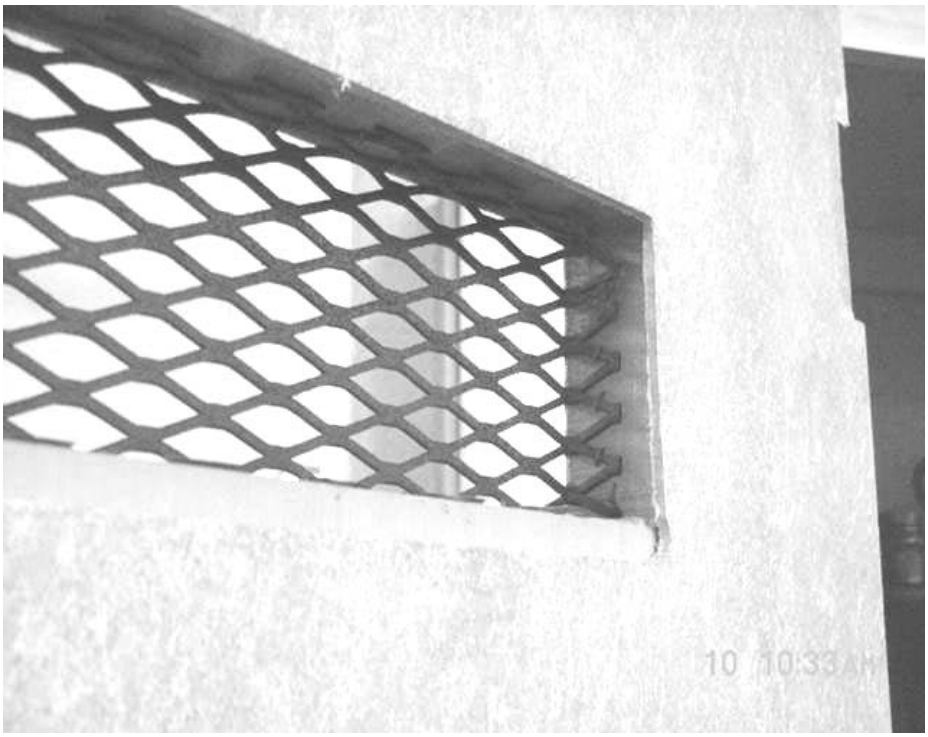
Picture 32

Wooden Box Labeled Phosphorous Pentachloride In Flammables Storage Cabinet In B-321 Prep Room, Note Crystallization On Label

Picture 33

Metal Container That Is Heavily Corroded in Flammables Storage Cabinet
Flammables Storage Cabinet In B-321 Prep Room
(Container Originally Had Aluminum Finish)

Picture 34



Heavy Rust on the Passive Vents of the Door of the Flammables Storage Cabinet
In B-321 Prep Room

Picture 35

Flask Sealed With Glass Stoppers Held In Place With String In The Flammables Storage Cabinet In B-321 Prep Room

Picture 36

Containers With Degraded Or Missing Labels In The Flammables Storage Cabinet In B-321 Prep Room

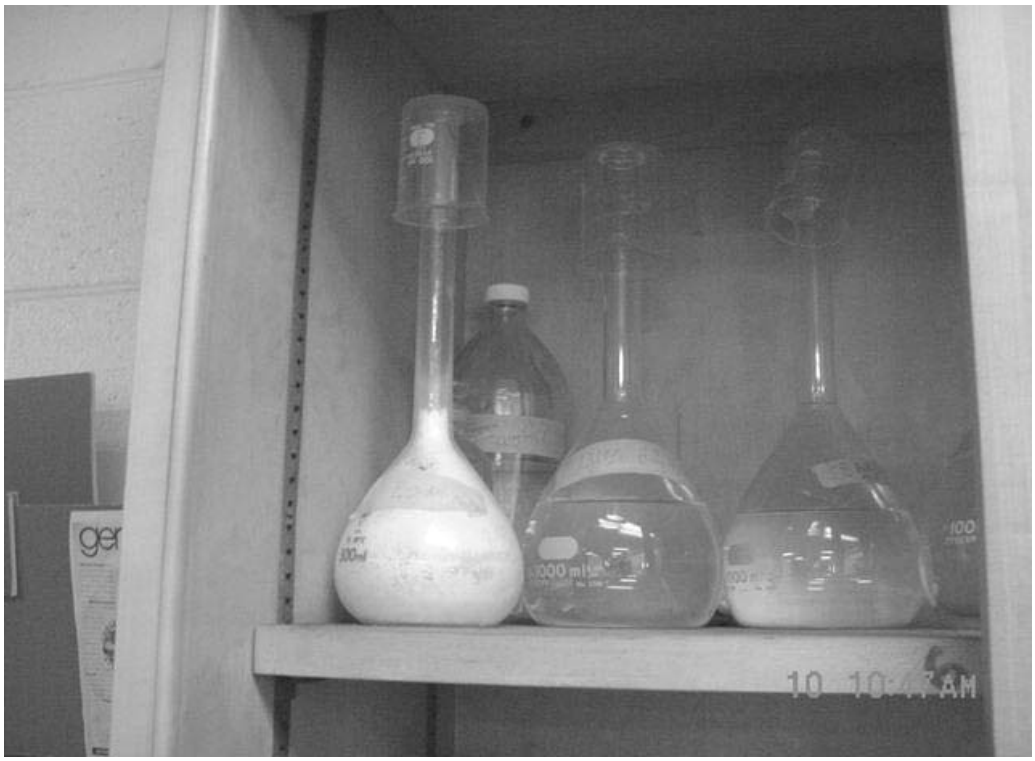
Picture 37

The Bottles Of An Unidentifiable Material Were Stored In A Cabinet Beneath A Sink In The B-323-Former Dark Room

Picture 38

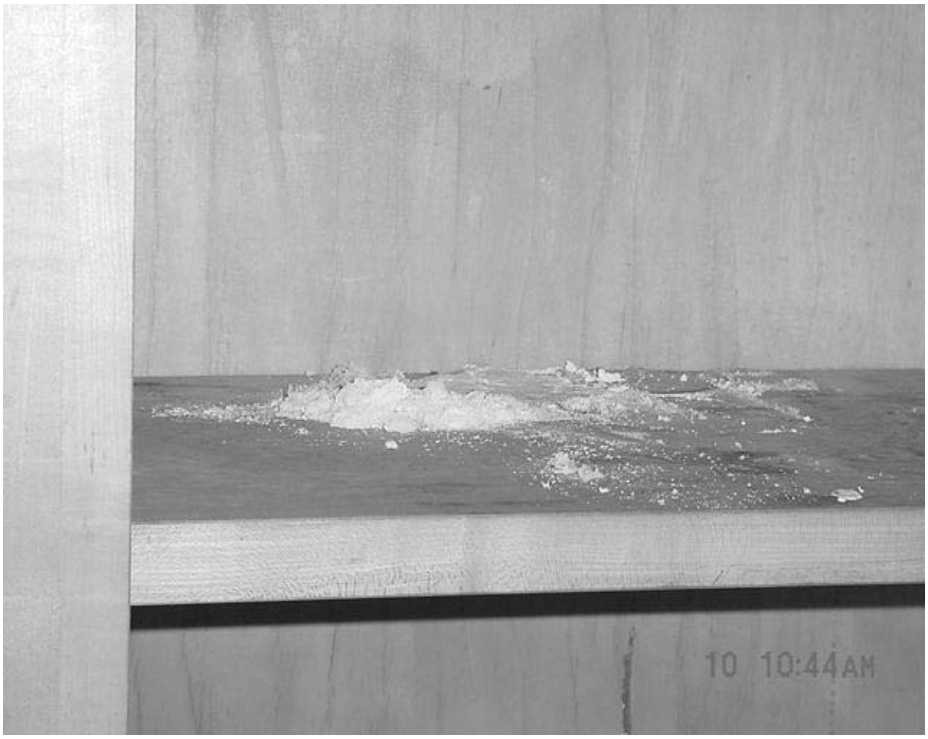
Crystallized Nitric Acid on Bottle Cap in Room B-316

Picture 39



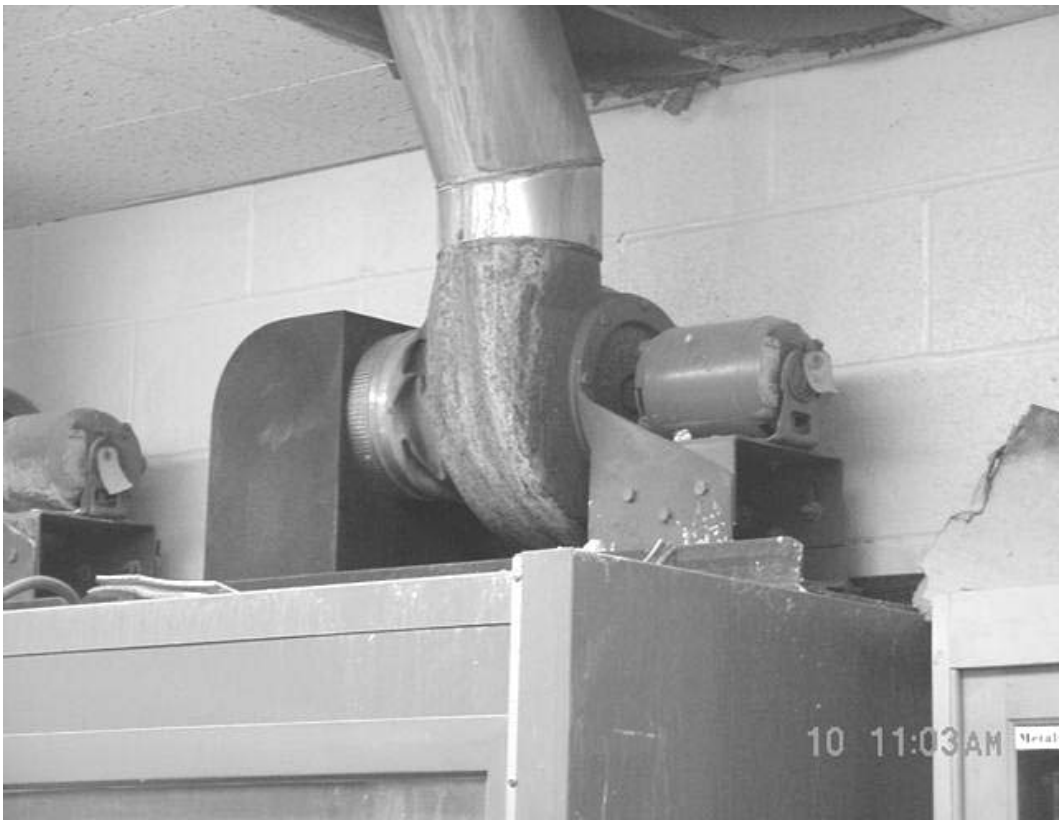
Containers of Crystallize Sodium Hydroxide Stored with Acids with Containers "Sealed" With Beakers in B-316

Picture 40



Spilled Powdered Residue of an Unidentified Substance in Cabinet in B-316

Picture 41



Ceiling Above the "Hexane" Chemical Hood in B-314

Picture 42

Glass of Cabinet Is Stained With A Black Material in B312

Picture 43

A Large Canvas Laundry Hamper Is Used To Collect Various Print Shop Wastes

TABLE 1

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	489	67	31					
Superintendent's Office Conference Room	743	76	28	5	Yes	Yes	Yes	Missing CT, carpet, window mounted A/C
Library	733	77	27	5	Yes	Yes	Yes	Numerous water damaged/ missing CT, carpet, roof leaks, loose diffuser-hanging, missing caulking
Media Office	788	78	27	0	No	Yes	Yes	Musty odors, carpet remnants under furniture, supply vent blocked with cardboard
Teachers' Break Room	657	78	25	0	No	Yes	Yes	Missing CT
Video Room	677	79	26	1	No	Yes	Yes	Chalk dust, missing CT, flammable materials in cabinet with cardboard & other materials, (former newsroom)
Closet (across from video room)					No	Yes	No	Passive supply vent, water damaged carpet, musty odors
AV Workroom	708	78	26	0	No	Yes	Yes	Water damaged CT-barrels to collect water

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 2

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Bates Office	728	72	28	1	No	Yes	Yes	
Charlotte Grant Office	830	79	26	0	No	Yes		2 personal fans, carpet, cloth curtains
Teachers' Learning Center	770	80	26	3	No	Yes (3)		Personal fan-on, 13 computers, carpet
Library Office	748	80	25	0	No	Yes (2)	Yes (3)	Photocopier, carpet, sink, 2 plants, water cooler on carpet
Librarian's Inner Office	830	79	25	0	No	Yes	Yes	Supply blocked with box-airflow "too strong"
Student Council Office	827	78	25	4	No	Yes	Yes	Supply blocked by wooden box, 2 plants, carpet, 2 missing CT, fire damaged CT, 5 water damaged CT, heat complaints, dry erase board
Media & Technology Office	808	78	27	0	No	No	No	3 missing CT, soot/fire damaged CT, carpet
Director of Language Arts Office	747	75	27	0	Yes			3 plants, personal fan, 4 missing CT, water damaged CT along far wall, air freshener odors, carpet
Title I Director's Office	721	77	27	1	No	Yes (2)	Yes (4)	Air purifier, personal fan-on, photocopier, carpet-water cooler

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 3

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								on carpet
Tech Specialist's Office	806	78	27	1	No	Yes	No	Supply blocked by box, 4 missing CT, cement floor, fiberglass above CT
Lisa Porter's Office	782	78	26	0	No	Yes	Yes	Holes in door
Jack Dempsey's Office	715	79	26	1	No	Yes	Yes	4 missing CT, broken CT, complaints-supply loud
Cafeteria-1st Floor	1221	75	26	~100	Yes	Yes	Yes	Window open, vending machine
Drafting Room	813	72	28	5	Yes	Yes	Yes	Supply and exhaust off, motor parts on univent, 6 plants, chalk, aquarium
Cafeteria-2nd Floor	1105	75	27	2	Yes	Yes	Yes	Supply and exhaust off, window open
Food Service Director's Office	1005	77	26	2	No	Yes		Personal fan, carpet
Faculty Room	1158	76	25	3	Yes	Yes	Yes	Supply and exhaust off, kitchen area-exhaust on, restroom-exhaust on/weak, vending machine, recyclables in cardboard box

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Guidance Counselor Suite	913	75	23	1	Yes	No	No	4 water damaged CT, door open
Guidance Counselor Dave's Office	991	76	25	2	Yes	No	No	Door open
SPED Office	847	76	25	1	Yes	No	No	Window open, photocopier, cans in cardboard box, flowers/vase, 2 missing CT
Mediation Program	987	76	25	2	No	Yes	Yes	Passive door vent, cleaning product
Seniors' Submaster Area	913	75	24	0	Yes	Yes		Univent (supply) off, exposed fiberglass
Boys' Restroom C3							Yes	Tobacco smoke odors (ETS)
Girls' Restroom C3						Yes	Yes	Passive door vent, ETS
C303	2750	74	32	17	Yes	Yes	Yes	Water damaged ceiling, wall crack
C3 Study	842	78	25	0	No	Yes	Yes	Supply and exhaust off
C3 Hallway								20+ water damaged CT

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 5

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
C320	1579	77	28	0	Yes	Yes	Yes	
C318	1797	88	28	23	Yes	Yes	Yes	Supply and exhaust off, window open, water damaged ceiling along beams, chalk dust
Pi Alley	1643	78	29	0	No	No	No	Severe water damage, clutter, recycling
C316	1206	77	24	0	Yes	Yes	Yes	Supply and exhaust off, window open, 8 plants-on univent, chalk dust
C314	1008	76	23	10	Yes	Yes	Yes	Supply and exhaust off, window and door open, water damaged ceiling-along beams, exposed fiberglass
C312	886	76	23	0	Yes	Yes	Yes	Supply and exhaust off, papers on univent, window and door open
C310	1795	77	27	13	Yes	Yes	Yes	Supply and exhaust off, window open
Cafeteria-3rd Floor	700	78	25	0	Yes	Yes	Yes	Ventilation off, window open, lights flicker
C323	1500	76	27	16	Yes	Yes	Yes	Ventilation off, window open, water damaged ceiling plaster,

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 6

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								chalk dust
C321	955	76	25	9	Yes	Yes	Yes	Ventilation off, window open, water stained wall, chalk dust
C319	1861	78	32	23	Yes	Yes	Yes	Stuffy, water damaged CT, window open, chalk dust
C315	938	77	24	3	Yes	Yes	Yes	Ventilation off, window open, chalk dust
C313	968	76	24	5	Yes	Yes	Yes	Ventilation off, window open, leaks around window frames
C311	1457	77	28	15	Yes	Yes	Yes	Window open, chemical odors, air freshener
C309	1234	77	27	17	Yes	Yes	Yes	Window open
C307	1157	76	25	5	No	Yes	Yes	Heat complaints
C306	960	77	23	4	No	Yes	Yes	Exhaust blocked by desk
C305	1711	72	42	9	Yes	Yes	Yes	Ventilation off, univent diffuser covered with items, window open
C303	1711	72	42	15	Yes	Yes	Yes	

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 7

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
C217	1240	77	27	1	No	Yes	No	Door open
C215	1549	76	28	15	Yes	Yes	Yes	Ventilation off, strong perfume odors, door open
C211	2445	76	29	15	Yes	Yes	Yes	Ventilation off
C209	912	75	24	7	Yes	Yes	Yes	Window open-water penetration around windows
Special Education	938	76	25	1	No	Yes	Yes	Exhaust vent blocked by bookcase
Faculty Restroom				0	No	No	Yes	Exhaust off
Special Education Office	768	75	23	4	No	No	Yes	
C206	802	75	25	3	No	Yes	Yes	Univent off, exhaust blocked
C205	2533	75	31	18	Yes	Yes	Yes	Ventilation off, window open
C203	1690	73	28	15	Yes	Yes	Yes	Window open, reports of headaches
C201	1209	73	27	13	Yes	Yes	Yes	Window open

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 8

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
C223	3130	75	35	16	Yes	Yes	Yes	Ventilation off
C221	2736	75	35	23	Yes	Yes	Yes	Window open, black stains on tile
Medford Teachers Assoc. Office	653	75	24	1	Yes	Yes	Yes	Ceiling mounted univent with A/C-reported leaks when A/C is on, 2 water damaged CT, photocopier, window open
B319 – Lab Lecture	849	74	23	4	No	Yes	Yes	
B314	701	77	30	1	No	Yes	Yes	3 vent hoods, 15+ water damaged CT, dry erase board
B306	700	79	22	6	No	Yes (2)	Yes	Personal fan, 10+ water damageed CT, ETS complaints (from back stairwell), dry erase board
B Wing – Back Stairwell								Cigarette butts in stair-rail post, ETS
B317	978	78	23	2	Yes	Yes		Plants, active leaks, dry erase board/particulate build up
B317 – Work/Supply Office								Ceiling mounted univent with A/C - leaks

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 9

Indoor Air Test Results – Medford High School, Medford, MA – May 8, 2001

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines	
Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 10

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	440	78	33					Weather conditions: clear/sunny
Health Office (main)	667	76	36	4	Yes	Yes	Yes	5 water damaged CT
Nurse's Office	660	76	35	0	Yes	No	No	4 water damaged CT
Supply/Break Room	720	76	36	0	No	Yes	Yes	
First Aid	717	76	36	0	No	Yes	Yes	
Treatment Room	685	76	36	2	No	Yes	Yes	
Restroom					No	Yes	Yes	Missing CT
Lecture Hall II	1066	77	36	14	No	Yes	Yes	Ventilation off
C220	1420	77	37	19	Yes	Yes	Yes	Ventilation off, broken window pane
C216	950	76	34	1	Yes	Yes	Yes	Ventilation off, window and door open, 23 occupants gone ~20 min., chalk dust

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 11

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
C214	1113	77	36	17	Yes	Yes	Yes	Window open, dry erase board/particulate build up in trays
C212	1467	78	37	15	Yes	Yes	Yes	Window broken
C210	1500	78	37	16	Yes	Yes	Yes	Chalk dust
Faculty Room	586	76	32	1	Yes	Yes	Yes	Ventilation off, window open
C208 (Maletesta Office)	1190	76	36	3	Yes	No	No	9 water damaged CT
Previti Office	596	76	31	1	Yes	No	No	Window mounted A/C, window open
Freshman Office	726	76	34	6	Yes	Yes	Yes	Plant over univent, window open
C111	1385	74	38	13	Yes	Yes	Yes	Ventilation off, computers on univent air diffuser, window open, chalk dust
C113	955	74	37	3	Yes	Yes	Yes	Window open
C122	1008	76	36	6	No	Yes	Yes	Exhaust ventilation off, door open

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 12

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
C119	1440	75	39	1	Yes	Yes	Yes	14 occupants gone < 5 min., window open
C121	892	75	37	1	Yes	Yes	Yes	18 occupants gone <5 min., ventilation off, window open, chalk dust
Community Center	694	75	33	2	No	No	Yes	Local exhaust-inactive
Assistant Superintendent's Office	1090	76	36	0	Yes	No	No	Window mounted A/C
Attendance Office	630	75	33	1	No	Yes	Yes	Air purifier, supply vent covered by sheet metal & plastic
Business Office	646	81	27	0	No	No	No	
Personnel Office	686	78	27	3	Yes	Yes	Yes	5 water damaged CT
Superintendent's Office	636	78	28	0	No	Yes	Yes	
Administration Break Room	610	78	30	0	No	Yes	Yes	Air diffuser missing from supply vent
Conference Room	683	77	30	2	No	Yes	Yes	

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 13

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Network/Accounts Office	626	78	31	0	No	Yes	Yes	Subdivided area
V222	525	79	31	1	No	Yes	Yes	Personal fan-on, 7 missing CT, numerous water damaged CT-active leak, ceiling mounted exhaust-off/backdrafting, wall mounted exhaust-on/obstructed by file cabinet (~11" away), 1 out of 3 ceiling mounted univents on, dry erase board, chalk dust
Girls' Restroom							Yes	Exhaust off/occluded, water damage, pipe leak, no soap
Training Room	510	78	32	1	No	Yes	Yes	Window mounted A/C, 7 missing CT, numerous water damaged CT
P.E. Office	543	79	32	1	No	Yes	Yes	Supply and exhaust off, personal fan on, carpet
V220	527	81	30	6	No	Yes	Yes	6 missing CT, 2 personal fans-on
Cage 3 / 4	555	81	29	0	No			Exterior door open, AHUs need repair, active roof leaks, ventilation off

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 14

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Ladies' Restroom							Yes	No faucet in 1 out of 2 sinks
Men's Restroom							Yes	
B201	452	79	30	10	Yes	Yes	Yes	Window and door open, 11 missing CT, 24 computers, dry erase board
B202	541	79	32	2	No	Yes	Yes	Carpet, personal fan-on
B203	419	78	30	0	Yes	Yes	Yes	10 plants-on univent, numerous missing CT, wall crack, dust, personal fan
B204	696	79	33	7	No	Yes	Yes	2 personal fans-on, 4 missing CT, 3 water damaged CT, dry erase board, chalk dust
B209	455	78	30	1	Yes	Yes	Yes	Window open, ~12 water damaged CT, dry erase board
B208	521	79	31	2	No	Yes	Yes	5 water damaged CT, personal fan-on, exterior door open
Fitness Center	581	74	31	4	No	Yes (3)	Yes	Personal fan-on, ceiling mounted univents-with A/C, water cooler on carpet, dry erase board

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 15

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Weight Room	474	72	31	1	No	Yes	Yes	Ceiling fan-inoperable
Cage 1 / 2	667	77	35	8	No	Yes	Yes	Supply and exhaust off
A-Wing – Foreign Language Dept.	559	76	30	1	Yes	No	No	Window open, 6 water damaged CT, air cleaner
A208	704	78	33	7	Yes	Yes	Yes	Ceiling mounted univent-off, exhaust off, window and door open, water leaks-over light fixtures, recyclables, 3 sinks, cleaning products, 4 plants, dry erase board, chalk dust, temperature complaints
Ladies Restroom A2							Yes	Exhaust off, 5 water damaged CT
A210 – Art Room	697	78	31	1	Yes	Yes		Ceiling mounted univent, window open, water damaged ceiling, 2 unvented gas stoves, 5 sinks-spaces around backsplash, dry erase board, chalk dust
Home Ec. Storeroom		80	32	0	No	Yes	Yes	Passive door vent, main frame equipment, food/spices

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 16

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
A205	773	78	31	10	Yes	Yes (2)	Yes	2 ceiling mounted univents, exhaust off, severe water damage-ceiling, 2 personal fans, window and door open, 2 kilns-vented-flexible duct
Storeroom							Yes	Exhaust off, cigarette butts, ETS odors, mold odor
A-Wing – Back Stairwell								Urine odor complaints
Director of Fine Arts Office	825	76	33	3	No	No	Yes	Water damaged CT, air cleaner, accumulated items, door open
Mrs. Dee's Office	963	75	36	1	Yes			Passive door vent, 6 water damaged CT, dried flowers, door open
Teacher's Lounge	562	75	31	0	Yes	Yes	Yes	Univent off, window open, plant near univent, photocopier, soda machine, water cooler
Teacher's Lounge-Kitchen Area	566	75	32	0	No		Yes	Passive door vent, door open, sink, 10 water damaged CT, missing CT, toaster oven, microwave
C110	623	75	32	9	`yes	Yes	Yes	Supply and exhaust off, window and door open, personal fan, plant

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 17

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
C112	879	76	33	12	Yes	Yes	Yes	Supply and exhaust off, books on univent, window open, plant, personal fan, wall crack, water damage/crack on ceiling, chalk dust, temperature complaints
C116	1220	75	36	7	Yes	Yes	Yes	Supply and exhaust off, books on univent, window open, wall crack, plant, chalk dust
C118	1705	75	40	13	Yes	Yes	Yes	Supply and exhaust off, water damaged ceiling-crack over window, 16 plants-on univent-7 with out drip pans, chalk dust
C120	804	75	32	0	Yes	Yes	Yes	Supply and exhaust off, window open, water damaged ceiling, window plantr-no drip pan, chalk dust
Girl's Restroom					No		Yes	Passive door vent, odor complaints-mildew
B-Wing Office – 2nd Floor	510	78	29	1	No	Yes (2)	Yes (2)	1 out of 2 exhust vents on, 5 plants, partial carpet, 5 missing CT, ~10 water damaged CT

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 18

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Data Processing	513	79	29	2	No	Yes (3)	Yes (3)	2 out of 3 supply vents blocked, personal fan-on, ~10 missing CT, spray cleaner
B218	533	79	29	1	No	Yes	Yes	~30 missing CT, personal fan-on
B222	692	78	32	13	No	Yes	Yes	Personal fan-on, 5 missing CT
B220	612	78	33	5	No	Yes	Yes	3 water damaged CT (ceiling replaced), chalk dust, dry eraseboard
B216	969	79	34	14	No		Yes	Supply sealed with tin, 3 small plants, chalk dust
B215	791	78	31	3	Yes	Yes	Yes	Supply and exhaust off, 6 water damaged CT, chalk dust
B214	529	79	32	0	No	Yes	Yes	Chalk dust
B211	673	79	33	8	No	Yes (2)	Yes (2)	6 computers, aquarium-algae, 2 plants-window planter, door open, chalk dust
Music Storeroom							Yes	Mold odors, instrument cases

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 19

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
A110	645	74	30	0	No	Yes	Yes	Supply and exhaust off
Uniform Room								Ceiling leaks, mold odors
Music Repair Room							Yes	Active leak
A108						Yes	Yes	Instrument storage, numerous water damaged CT
Parent Info Center	797	75	31	5	No	Yes	Yes	2 plants, water cooler on carpet, photocopier
Gifted/Talent Office	842					Yes	Yes	Supply covered, cement floor
C1-Junior's Sub-master Office	983	75	37	0	Yes	Yes		2 water damaged CT, 1 broken CT, supply off
Sub-master Ross	741	75	34	4	Yes	No	No	Window mounted A/C, 2 water damaged CT, 4 plants, window open
Psychologist's Office	576	74	32	1	Yes	No	No	Window open, 5 water damaged CT, plant, chalk dust
Storeroom							Yes	Passive door vent (supply), ~20 missing CT, 2 personal fans, refrigerator, water damage-active

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 20

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								leak-aluminum bowl to catch leaks
Guidance/Reception	950	74	35	1	No	No	Yes	30+ water damaged CT, small plant
Mrs. Foti's Office	875	75	35	1	No	No	No	Window mounted A/C, photocopier, 6 water damaged CT, door open
Director of Guidance	860	75	35	0	Yes	No	No	Missing CT, door open
Adjustment Counselor	1046	75	36	0	Yes		No	Passive door vent, plant
Mrs. Wax's Office	870	75	35	0	Yes		No	Passive vent, area rug
A201	626	77	33	10	Yes	Yes	Yes	Chronic water stain along ceiling junction, periodic leaks, exhaust vent off
A203	687	76	33	5	Yes	Yes	Yes	Supply and exhaust off, window and door open
Foreign Language Storeroom								Ceiling leak/water damage, water damaged boxes
Restroom						Yes	Yes	Passive vent sealed, faucets broken

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 21

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Storage Room	502	74	30	0	No	Yes	Yes	Exhaust off
A123	543	73	33	0	Yes	Yes	Yes	Chalk dust, complaints of temperature extremes in winter (esp. lack of heat)
A125	499	73	33	0	Yes	Yes	Yes	Chalk dust
Music Library	521	72	34	0	Yes	Yes	Yes	Vehicle exhaust complaints
Boys' Locker Room				0	No	Yes	Yes	Restroom-exhaust off-clogged toilet/stagnant water, ceiling mounted AHU-not operational, steam leak-back room-damaged insulation
Gym/Hallway-2nd Floor								Active roof leak/water damage at expansion joint
Men's Restroom - Cage 3						Yes	Yes	Excessive heat, missing radiator case, urine odors
B314	820	78	24	3	No	Yes	Yes	Supply off, 10+ water damaged CT, door open
B310	721	79	20	0	No	Yes	Yes	Missing louver – exhaust vent, door open

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 22

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
B312	768	79	21	17	No	Yes	Yes	Supply and exhaust off, 20+ water damaged CT
Xerox Room	758	79	21	0	No	Yes	Yes	5+ water damaged CT, photocopier-chem hood, missing louvers on vents
B308	753	81	21	21	No	Yes	Yes	Chalk dust, dry erase board
B306	777	80	22	9	No	Yes	Yes	~10 missing CT, floor fan, dry erase board, door open
B302	737	79	23	12	No	Yes	Yes	2 missing CT, 10 water damaged CT, door open
B305	1098	74	28	21	Yes	Yes	Yes	Supply off, sink, door open, 20+ missing/water damaged CT
B307	914	77	22	20	Yes	Yes	Yes	Supply and exhaust off, window and door open, sink
B309	597	76	22	0	Yes	Yes	Yes	Supply and exhaust off
B221	879	77	24	19	No	Yes	Yes	Exhaust off, 10+ water damaged CT
B222	631	77	19	0	No	Yes	Yes	5+ water damaged CT, door open

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 23

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
B219	1094	76	27	12	Yes	Yes	Yes	Supply and exhaust off
OT Dept.	518	78	18	1	Yes	Yes	Yes	Supply and exhaust off, rubber odor-mat, 5 water damaged CT, door open
Make Way for Kids	490	82	17	4	Yes	Yes	Yes	Supply and exhaust off, window and door open, 5+ water damaged CT
Speech/Language	549	83	17	1	Yes	Yes	Yes	Supply and exhaust off, window open, window mounted A/C, 5+ water damaged CT
Electrical Shop	494	85	17	5	Yes	Yes	Yes	Window and door open, exhaust off, water damaged CT, ceiling fan, temperature complaints-cold in winter
V201 – Electrical Shop Classroom	488	85	19	2	Yes	Yes	Yes	Supply and exhaust off, exhaust blocked by file cabinet, window and door open, water damaged CT
V202 – Print Shop	541	84	20	7	Yes	Yes	Yes	Supply and exhaust off, exhaust vent blocked
V211 – Wood Shop	502	85	17	8	Yes	Yes	Yes	Supply and exhaust off, window and door open

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 24

Indoor Air Test Results – Medford High School, Medford, MA – May 11, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
V213	1194	83	19	19	No	Yes	Yes	Supply and exhaust off, water damaged plaster
Painting & Decorating/Home Improvement	576	84	22	4	Yes	Yes	Yes	Supply and exhaust off, dry drain, door open
Metal Shop	590	80	23	8	Yes	Yes	Yes	Supply and exhaust off, door open, metal
Metal Shop	581	90	14	0	Yes	Yes	Yes	Supply and exhaust off
Automotive	502	82	22	5	Yes	Yes	Yes	Supply and exhaust off, window and door open, hole in walls
		80	26	7	Yes	Yes	Yes	Supply and exhaust off, dooropen

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 25
Medford High School Room 321
Chemicals Stored in Flammables Storage Closet

Chemical	Quantity
1,1,1-trichloroethane	1 1-pint bottle
1,2-dichloroethane	1 1-pint bottle
2-propanol	1 1-gallon bottle
Acetone	1 8-quart bottle
Acrylonitrile	500 gm bottle
Amyl Acetate	1 1-gallon bottle
Benzene	1 2-quart bottle
Benzene	1 1-pint bottle
Benzene reagent	3 1-pint bottles
Butyl alcohol	1 1-pint bottle
Carbon tetrachloride	1 bottle
Carbon tetrachloride	1 8-quart bottle
Carbon tetrachloride	2 1-pint bottle
Chloroform	1 1-gallon bottle
Collodion	1 1-gallon bottle
Cottonseed oil	1 1-gallon bottle
Cottonseed oil	5 1-pint bottle
Cottonseed oil	1 1-gallon bottle
Ethyl alcohol	1 1-gallon safety can
Ethyl alcohol	1 1-gallon metal can
Ethyl acetate	1 1-gallon safety can
Ethylene glycol	1 1-pint bottle
Formaldehyde	1 5-pint bottle
Formaldehyde 37%	3 1-gallon bottles
Glycerine	3 1-pint bottles
Glycerol	8 1-pint bottles
Isoamyl alcohol	1 1-pint bottle
Isopropyl alcohol	1 1-pint bottle
Isopropyl alcohol	2 1-gallon safety can
Methyl alcohol	2 1-pint bottle
Methyl alcohol	1 1-gallon bottle
Methyl methacrylate	1 1-pint bottle
Motor oil	6 1-quart bottles
Petroleum ether	2 1-pint bottle
Petroleum ether	1 5-gallon drum
Phosphorous pentachloride	Wooden box
Propanol	1 1-quart bottle
Toluene	1 1-pint bottle
Xylene	1 8-pint bottle
Xylene	1 5-pint bottle in cardboard box
Xylene	1 8-quart bottle
Xylene	2 1-pint bottle
Xylene	2 1-gallon safety can

Table 26
Medford High School Chemicals stored in chemical storage closet

Chemical	Quantity
1,1,1-trichloroethane	1 1-pint bottle
1,2-dichloroethane	1 1-pint bottle
2-propanol	1 1-gallon bottle
Acetone	1 8-quart bottle
Acrylonitrile	500 gm bottle
Amyl Acetate	1 1-gallon bottle
Benzene	1 2-quart bottle
Benzene	1 1-pint bottle
Benzene reagent	3 1-pint bottles
Butyl alcohol	1 1-pint bottle
Carbon tetrachloride	1 bottle
Carbon tetrachloride	1 8-quart bottle
Carbon tetrachloride	2 1-pint bottle
Chloroform	1 1-gallon bottle
Collodion	1 1-gallon bottle
Cottonseed oil	1 1-gallon bottle
Cottonseed oil	5 1-pint bottle
Cottonseed oil	1 1-gallon bottle
Ethyl alcohol	1 1-gallon safety can
Ethyl alcohol	1 1-gallon metal can
Ethyl acetate	1 1-gallon safety can
Ethylene glycol	1 1-pint bottle
Formaldehyde	1 5-pint bottle
Formaldehyde 37%	3 1-gallon bottles
Glycerine	3 1-pint bottles
Glycerol	8 1-pint bottles
Isoamyl alcohol	1 1-pint bottle
Isopropyl alcohol	1 1-pint bottle
Isopropyl alcohol	2 1-gallon safety can
Methyl alcohol	2 1-pint bottle
Methyl alcohol	1 1-gallon bottle
Methyl methacrylate	1 1-pint bottle
Motor oil	6 1-quart bottles
Petroleum ether	2 1-pint bottle
Petroleum ether	1 5-gallon drum
Phosphorous pentachloride	Wooden box
Propanol	1 1-quart bottle
Toluene	1 1-pint bottle
Xylene	1 8-pint bottle
Xylene	1 5-pint bottle in cardboard box
Xylene	1 8-quart bottle
Xylene	2 1-pint bottle
Xylene	2 1-gallon safety can

TABLE 26
Medford High School Room B-314
Acids Stored In Wooden Cabinet

Chemical
Glacial acetic acid
Hydrochloric acid
Nitric acid

TABLE 27
Medford High School Room B-314
Chemicals Stored In Wooden Cabinet

Chemical	Quantity
Aniline hydrochloride	500 gm bottle
m-amyl alcohol	500 ml bottle
t-butyl alcohol	1 pint
p-dichlorobenzene	1 kg bottle
Dimethylglyoximine	4 oz. Bottle
Iotic acid	1 bottle
Naphthalene	1 ¼ lbs.
Hexane	1 pint

TABLE 28
Medford High School Total Volatile Organic Compound Measurements Within The Vocational Educational Programs
April 14, 2001

Area	Location within Area	TVOCs *ppm
Outdoors	Outside front door	0.6
V 202 Print Ship	At hallway door	4
V 202 Print shop	At center of room	7
V 202 Print shop	In laundry bin with discard printing materials	15
V 202 Print shop	At opening for orange hand cleaner	198
V 202 Print shop	1 inch over open trough of fluid	301
V 211 Wood shop	At the center of room	4.7
V 211 Wood shop	Around student applying stain	15
V 212 Painting & Decorating	Center of Room	2.2
V 213	Center of room	1
V 219 Metal Fabrication/HVAC Engineering	Center of Room	2.2
V 215	Center of room	7.4
V 118 Cosmetology	In general area of student applying hairspray	5.2
V 118 Cosmetology	Center of room	1.1
V 118 Cosmetology Basic Room	At center of laundry room with detergent on floor	1.0
V 118 Cosmetology Basic Room	Over open container of detergent	22
V 221 Automotive	Center of area with 2 exterior wall doors open	0.6

* ppm = parts per million